

### **III.A.13 SECA Core Technology Program Activities – PNNL**

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#### **Objectives**

- Identify and prioritize technology development needs
- Disseminate technical information to Solid State Energy Conversion Alliance (SECA) industrial teams
- Coordinate SECA Core Technology Program (CTP) activities
- Participate in and organize technical and topical meetings and workshops
- Publish and present technical papers and reports

#### **Approach**

- Hold SECA CTP meetings to present technical findings
- Organize topical area workshops to identify and prioritize tasks
- Provide quarterly, annual and topical reports
- Meet with industrial clients on a regular basis
- Lead and organize technical society meetings

#### **Accomplishments**

- Held SECA CTP workshops
- Provided quarterly progress reports and topical reports to SECA participants
- Held workshops at Argonne National Laboratory (ANL) and Pacific Northwest National Laboratory (PNNL) on solid oxide fuel cell (SOFC) interconnection and Cr evaporation
- Developed an alloy development and corrosion mechanism evaluation plan with University of Pittsburgh, Albany Research Center and Allegheny Technology, Inc.
- Published technology update on silica transport
- Presented invited lectures at technical societies, universities and industries
- Organized American Society for Metals (ASM), American Ceramic Society (AcerSoc) meetings on SOFC technology

#### **Future Directions**

- Hold SECA CTP meetings and topical workshops
- Provide topical and CTP progress reports to SECA participants
- Develop technology roadmap in consultation with industries
- Provide technical solutions to SECA participants
- Organize technical society meetings to exchange technical information

- Publish technical findings in national and international journals
- Prioritize technology development needs in conjunction with industry teams

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## **Introduction**

The purpose of the Solid State Energy Conversion Alliance Core Technology Program (SECA-CTP) at PNNL is to focus universities, national laboratories, and other research agencies toward finding solutions to the crosscutting technical barriers in the development of low-cost, high-power-density solid oxide fuel cells (SOFCs) for a broad range of applications meeting SECA's cost and performance targets. This project will emphasize the development of materials and cost-effective fabrication techniques for the various components in the SOFC stack (electrolyte membrane, cathode, anode, interconnect, and seals). Computer modeling will be advanced and used to simulate and optimize the SOFC stack and system design and to verify the dependence of thermal, mechanical, and electrochemical properties on materials selection and geometry. The results will be disseminated/ transferred to all SECA industry teams and to appropriate CTP participants. The project will develop technology roadmaps as well as identify and prioritize technologies to be made available for use by all of the industry integration teams within SECA. A modular approach to system design will be emphasized. The ability to manufacture modular SOFC units at low cost allows the SOFC technology to penetrate a number of power generation markets, e.g., stationary distributed power units, portable military power units, and auxiliary power units for vehicles. High efficiency coupled with multi-fuel capability makes the system ideal for hydrocarbon- and coal-based fuel utilization with the potential for CO<sub>2</sub> sequestration.

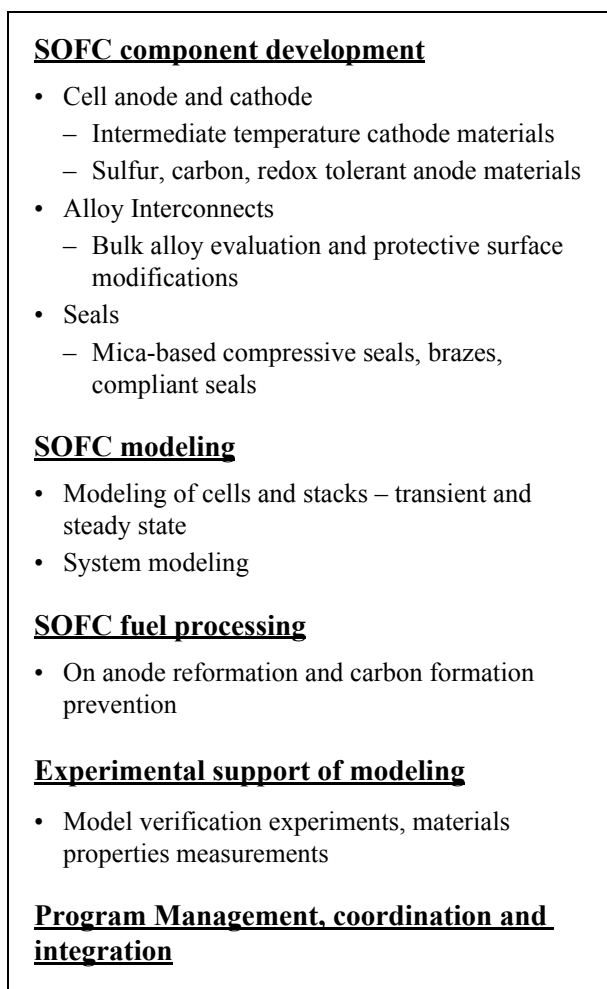
The management of SECA's Core Technology Program will continue to involve interactions with universities, national laboratories and industrial team members on a frequent basis to disseminate technical information gained through workshops and meetings. The management activity will involve holding workshops and topical area meetings with Industry Integration Team (Core Technology Program and government sponsored) representatives. These workshops will ensure that research is adequately

progressing and is addressing the current R&D as well as technology needs of the industry teams. The topical workshops will also be a forum to identify and prioritize other technical issues (that had not been addressed) and to promote technology transfer. Technical roadmaps will be updated and used to focus research activities. Additionally, PNNL and the National Energy Technology Laboratory (NETL) will provide oversight and the necessary review of projects that are part of the CTP. These activities will require travel and coordination with the Core Technology Program participants. PNNL will work with the NETL Project Management Team and provide recommendations from the CTP participants about technology issues/gaps that should be addressed.

The national Core Technology Program management will facilitate the exchange and dissemination of technical information, generated by the SECA-CTP participants, in a timely manner to all SECA industrial team members. The information exchange and dissemination will be achieved through meetings, workshops, written topical reports, and documents. During FY 2005 and beyond, the program management takes the added responsibility of providing technical discussions and progress reports to industrial teams on a pre-scheduled basis to expedite the development of SOFC power generation systems that meet the goals and objectives of the SECA initiative. The Core Technology Program will also interact with other government agencies to gather and disseminate technical information related to SOFCs. Program management will work with the thrust area leaders and CTP participants to define tasks, technical milestones, schedules, and deliverables. Both short-term and long-term progress and accomplishments will be reviewed internally. Technical experts in the areas of interest will be consulted from time to time to provide technical support and guidance.

## **Approach**

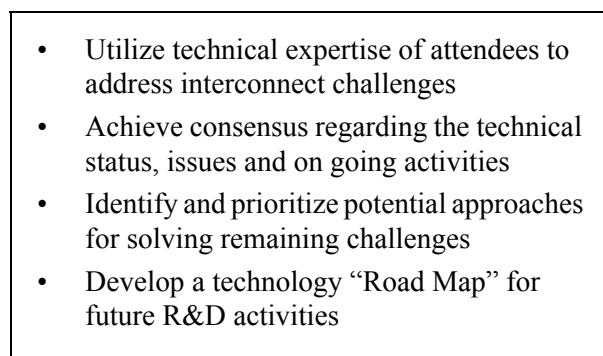
To meet the overall cost and performance targets of the Solid State Energy Conversion Alliance, the



**Figure 1.** SECA CTP Activities at PNNL

SECA CTP will focus on coordinating technology development activities at universities, national laboratories and industries. Technical findings will be disseminated through topical reports. Technology gaps will be identified, and workshops will be held to develop roadmaps. Approaches for FY 2005 include the following:

- Hold frequent meetings with industrial teams to discuss technical progress. Provide a written report to each team member summarizing the status.
- Provide quarterly progress reports describing the technical status and issues, if any.
- Provide topical/annual reports after completion of the task.
- Hold workshops to present the technology status. Also, use the workshop as the forum to develop consensus and prioritization of technical activities.



**Figure 2.** Workshop Objectives and Goals

- Organize and participate in the Annual SECA Program Review Meeting.
- Participate in national/international meetings to present status/findings.
- Coordinate with technical societies.
- Coordinate with NETL on all aspects of the SECA CTP.
- Responsibilities related to SOFC modeling include university interactions, training and workshops including the development of a master modeling plan and organizing and providing a training course for all SECA industry teams.

In FY 2005, a workshop on SOFC interconnects and Cr transport was held to review the technology status and disseminate the technical findings to SECA industry teams. A technology roadmap was developed. A training session was conducted to present the recent advances in the modeling software to SECA members. In FY 2006 and beyond, this exercise will be repeated and new findings presented. Ways to expedite early validation of on-going cell component materials development work will be examined in consultation with the CTP coordination team. Figures 1 and 2 show PNNL technical activities and workshop objectives.

## **Results**

SECA CTP workshops were held in Tampa, Florida, and Pacific Grove, California, to review technical progress made in core thrust areas related to materials, modeling, fuel processing, power electronics and manufacturing. Two additional topical workshops were held at ANL and PNNL to understand and develop roadmaps for SOFC current

collectors/gas separators and Cr evaporation in oxidant gas atmosphere. Input from industry teams and materials manufacturers was extensively utilized for the development of advanced concepts. A review of high-temperature silica transport in SOFC environment was presented at the American Ceramic Society. Several invited lectures were given at technical society (ASM, AcerSoc, TMS, AVS, ECS, etc.) meetings. SOFC technology and technology status were also presented at universities (University of Connecticut, University of Pittsburgh, Georgia Institute of Technology, etc.) to help familiarize and train students and teaching staff. Technical society meetings were organized to bring forward experts working in the field and disseminate information to industrial participants and academia with the ongoing research activities.

### **Conclusions**

The SECA Core Technology Program at PNNL emphasizes the development of advanced component materials, modeling and design tools, and fuel processing techniques as well as coordinates technology development activities at universities, national laboratories and industries. Core

Technology facilitates the exchange and dissemination of technical information, generated by the SECA-CTP participants, in a timely manner to all SECA industrial team members. The information exchange and dissemination is achieved through meetings, workshops, written topical reports, and documents.

### **FY 2005 Publications/Presentations**

1. P. Singh and L. Pederson. "Coatings and Deposition Processes for Solid Oxide Fuel Cells: A Review" *International Conference on Metallurgical Coatings and Thin Films, American Vacuum Society, 2005.*
2. P. Singh. "Corrosion Processes in Bi-Polar Dual Atmosphere Conditions" *Gordon Research Conference, Colby Sawyer College, NH, 2005.*
3. P. Singh. "SOFC Power Generation Systems: Technology Status and R&D Needs" *Connecticut Global Fuel Cell Center, University of Connecticut.*

### **References**

1. P. Singh et al. "Vapor phase silica transport during SOFC operation at 1000C", *29<sup>th</sup> International Conference on Advanced Ceramics and Composites, American Ceramic Society, January 2005*